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AN ECONOMETRIC APPROACH TO EVALUATE NAVY ADVERTISING EFFICIENCY

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AN ECONOMETRIC APPROACH TO EVALUATE NAVY ADVERTISING EFFICIENCY

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I. INTRODUCTION

The aftermath of the end of the Cold War and the collapse of the former Eastern Bloc and the Soviet Union, along with other dramatic changes in world politics over the past seven years, thrust the United States Armed Forces into significantly different circumstances than those encountered in the previous decades. One of the major impacts of these changes is right sizing, i.e. downsizing to lower end-strength targets according to a changed threat situation. Although forces are being cut from all ranks, the public perceives downsizing as a situation of diminished enlistment opportunities. These public expectations, along with the special needs of the Navy's internal labor market, make Commander Naval Recruiting Command's (CNRC) marketing job even more difficult than in the past. Effective advertising is a crucial part of the recruiting process and, as such, should play an important and increasing role in maintaining the readiness of the U.S. Navy. Budget pressures, on the other hand, make it difficult to simply allocate more money to high-quality (HQ) recruiting. However, increasing CNRC's productivity and optimizing its efficiency is the solution at hand. This work reviews the efficiency of Navy advertising in previous years, and provides an analysis of Navy advertising expenditures over the period October 1991 through March 1995.

The foremost purpose of this thesis is to estimate optimal levels of advertising budgets and advertising type combinations. It investigates the U.S.Navy advertising expenditures and the marketing environment of FY1992 - FY1995 and, in a second step of the analysis, it determines the deviations from the optimal levels to come up with

efficiency/ inefficiency measures. Statistical and econometric analysis of relevant and available data is used to examine relationships between advertising and contracts. The thesis sets out to specify the cost-efficient levels of advertising expenditures needed to supply varying numbers of contract attainments in a rapidly changing demographic and socioeconomic environment. Findings of the study will be helpful to more precisely determine, justify, and defend advertising budget requests, both current and future, to support the contract mission of CNRC with an appropriate level of advertising funding. Due to problems in availability of appropriate data, both from CNRC and other sources, the thesis provides only general results. It concludes with recommendations for follow-up studies and specifies data collection requirements for particular areas in the Navy's marketing process.

II. METHODOLOGY FOR MEASURING ADVERTISING COST EFFICIENCY

A. GENERAL CONSIDERATIONS

The problem of determining advertising budgets has existed for a long time in the civilian sector without definitive answer. Most organizational units have some ideas as to what is adequate, but the actual decision on how much money to spend on what particular media comes from a rule of thumb: usually, the amount spent is a constant proportion of a sales decision.

The cost of advertising is difficult to justify, probably more so in the public sector than in the private sector. Measuring advertising efficiency is the central problem. How well has public money been spent to meet recruiting goals? Although few completely refute the usefulness of advertising to a marketing effort, the issues the Navy struggles with are proving actual budget requirements and demonstrating the positive relationship between expenditures and outcomes. Although the need to assess advertising efficiency is widely acknowledged, there is almost no agreement on how to measure it.

Navy advertising creates and maintains an overall awareness of product benefit that leads to a higher propensity to respond positively to some independent stimulus, such as a Navy advertising spot on TV. The main objective of Navy advertising is to create "top of mind" awareness of Navy issues, something measured quite crudely. CNRC can point to certain propensity figures as recorded in tracking surveys, such as the Youth Attitude Tracking Study (YATS) or the New Recruit Surveys (NRS), and assert that

advertising created awareness of Navy job opportunities. However, it cannot prove that lowering advertising exposure achieves less awareness, nor can it prove what incremental improvements result from doubling the media budget. Finally, CNRC cannot easily quantify the importance of awareness relative to other factors such as recruiter influence, collateral publicity, promotional programs, physical qualifications, personal circumstances of potential recruits, and other factors which influence the enlistment decision.

How can the Department of the Navy (DoN) and CNRC determine what level of spending is warranted? Both ad hoc and methodical calculations suggest different spending levels, many of which seem rational and practical. An ad hoc method, for example, bases current spending on a percentage of the previous year's allocation, or on some measure relative to the number of high-quality recruits needed. On the other hand, an optimal criteria for determining levels of media spending maximizes the return due to expenditures on advertising. The return can be assessed by measuring the number of contracts attained or the number of people in the target market made aware of certain Navy occupational opportunities by the impressions-leads relationship. The measure of awareness, in turn, may be best captured by examining the impressions (impression is defined as an exposure of one individual to one advertisement) generated by an advertisement campaign and the number of qualified leads generated through those advertisements.

CNRC's strategy for justifying changes in past and future budgets might be to stress the long-term effects of advertising. It is likely that if advertising is viewed as a cost, funding for it will decline. If it is viewed as an investment in the Navy's future,

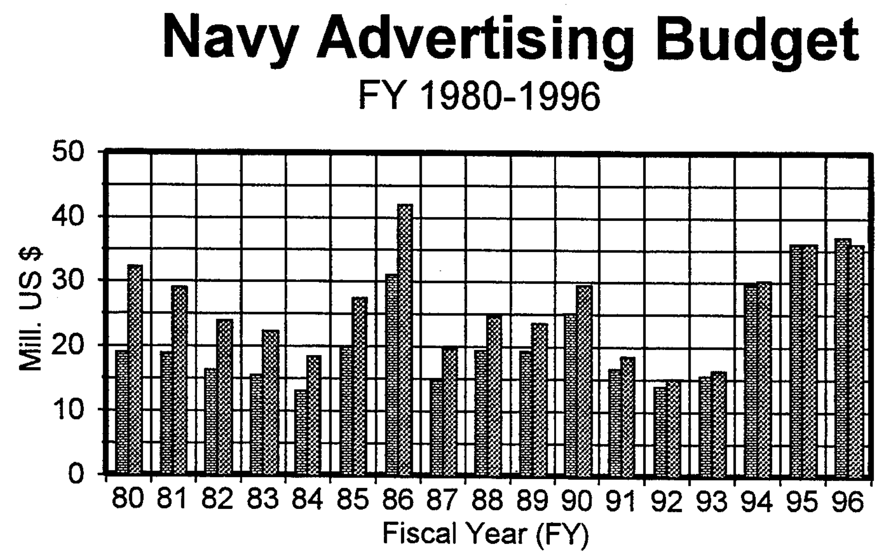


FIGURE 1:**Navy Advertising Budget**

Left Bars: Current Dollars, Right Bars: Constant Dollars, Base Year = 1995

i.e. 'an investment in a stock of intangible awareness capital' (Goldberg, 1991), it is easier to justify (see Figure 1 for budget developments in the last 17 years). CNRC's argument might follow economic theory: to justify the budget, CNRC must find the level of media spending which maximizes the return on investment and optimizes the use of advertising expenditures. For all organizations defending advertising expenditures is difficult. The central issue is measurement:

> "Accountability means that advertising expenditures are now tested on financial criteria alongside all other possible expenditures. The problem with this, from the standpoint of advertising, is that traditionally advertising has been unable to demonstrate that it is generating an optimal return, or whether more spending or less spending is warranted. Lacking information for a valid comparison, the easiest thing for top management to do is simply cut advertising, because of advertising's inability to justify itself on a return on investment basis." (Danaher and Rust, 1994, p.28).

B. LITERATURE REVIEW

1. Basic Findings

Despite a vast literature, no strong consensus has emerged to quantify the effect of advertising on sales of consumer products, much less on the number of military enlistments. Advertising efficiency depends on the creative and informational content of the delivered message. Additionally, efficiency depends upon consumption attributes of the target market, the marketing network, and competitive aspects of the good, service or occupation being sold. Researchers and policy-makers addressing military advertising approach the problem of quantifying the effects of advertising in one of two ways. Some declare advertising unmeasurable; others use inferential techniques to examine the effects of advertising expenditures on sales (contracts) without specifically stating how advertising works. Inferential techniques require researchers to look simultaneously at all the factors bearing on an enlistment decision, and account for them by using relative costs and environmental measures. Traditionally, cost measures, such as advertising, recruiter salaries and expenses, bonuses, and other pecuniary benefits have been used as the variables which affect the enlistment decision. Recruiter incentives, such as assigned missions, and market factors, such as unemployment rate or pay differences, have also been included to represent other factors bearing on enlistment. See Morey and McCann, (1983), for a complete overview of determining factors in a military personnel supply model.

Two types of inferential studies attempt to validate the efficiency of advertising. Experimental studies control advertising levels by geographical region. An experimental

study, based on statistically comparable area , models costs and outputs (for example, contracts signed in an area versus advertising in that area). Data-based studies analyze costs and other data for successive historical periods, evaluating how much each expenditure in each period contributed to changes in a subsequent period. The results are expressed in terms of elasticities.

Both experimental and data-based studies face difficulties because advertising, though important, ties only relatively weakly to the enlistment decision process. Several studies on the U.S. Navy address the issue of advertising effects. See Bayus et al , (1985), Goldberg, (1982), Hanssens and Levien, (1982), and Morey and McCann, (1983).

Additionally, the advertising industry measures and reports delivery of advertisements in a manner difficult to analyze and to compare for econometric modeling. Much of the recruiting and market data that go into the measurement and evaluation of advertising efficiency are specific to a national district or artificial market areas. For example, the syndicated services (such as Nielson) measure exposure of national advertising by surveying the population using samples that (generally) cannot be projected across different geographical areas. Further, local media advertising are not as well measured as those in national media, and advertising response times differ by media, warranting careful study of lag and lead times. Finally, it is difficult to quantify the role of advertising in gaining different levels of response; one could measure the effect of advertising results on the number of leads, applications, contracts, accessions, or shipments to basic-training facilities or A-schools.

The following sub-sections 2. and 3. review specific literature relevant to this thesis. In general, these studies have been marred by weak data, model inflexibility, and econometric techniques that fail to incorporate important aspects of the enlistment process. Three specific problems are common to the studies: potential nonlinearities in consumer responses, substantial leads and lags in the advertising-sales relationship, and the absence of refined data.

A threshold or minimum level of advertising may be necessary to induce increases in sales. Beyond this point, sales continue to rise with advertising (saturation), but eventually diminishing returns are thought to dominate (over saturation), possibly implying an S-shaped advertising response curve. This seems a reasonable analogy to the stimulus-response function of mathematical psychology, a so-called advertising response function (Rao, 1970). Typical research uses constant elasticity over the relevant range (a log-linear relationship between advertising and sales). For an alternative specification that is flexible enough to accommodate both effects simultaneously, see Johansson (1979). The S-shaped curve could also imply the absence of a discernible effect on recruits from an advertising budget that is too big or too small.

Causal relationships between sales and advertising are complex and dynamic. However, the effect of advertising is likely to be cumulative. Sales increase immediately following a rise in advertising expenditures, but often diminish subsequently ("decay" over time). However, "fresh" advertising efforts may have different effects than "stale" or "overused" messages. Models that consider only contemporaneous effects without

considering previous and future response are of limited use in quantifying the sales-advertising relationship.

Available measures of advertising expenditures do not typically distinguish among alternative media purchases. Total advertising budgets may not vary enough to evaluate a wide range of expenditure levels; they cannot reveal the influence of each advertising-sales determinant. Despite all the problems mentioned above two different research designs have been used to attempt to explain the advertising-sales/recruiting relationship.

2. Experimental Studies

In the late 1970s and mid-1980s, an adjunct of the Wharton School of Business at the University of Pennsylvania conducted two market experiments on advertising for the Department of Defense (DoD). Wharton's famous marketing experiment in the 1950s gives it a reputation as the leader in market studies. The first Wharton test, although not well documented, showed national advertising to be insignificant with respect to realizing new enlistments (1978/79). The second Wharton experiment, a year-long study titled the "DoD Advertising Mix Test" (Carroll, 1987), included all advertising by the military services and the Joint Recruiting Advertising Program (JRAP). The Office of the Secretary of Defense (OSD) mandated the study, apparently intending to prove that joint-service advertising was more cost-effective than individual service programs. Wharton indeed found joint-service advertising cost-effective; however, RAND later evaluated the study, and indicated that poor documentation, questionable design, and other problems rendered the findings non-verifiable, and not reliable for making policy decisions.

RAND's findings are not surprising in view of industry experience with market tests. In the mid-1980s, The Advertising Research Foundation conducted a workshop on market tests. Many of the workshop presenters reported on the reasons why their experiments did not deliver the results expected. One major reason among others for failure of market tests is that salespeople compensate for lowered advertising in the short run by working harder to gain sales. In the case of the military, recruiters facing lowered awareness among target enlistees call more potential recruits, and push harder to get contracts signed. Additionally, frequent changes in the level of advertising expenditures occur, and controlling the changes is difficult, costly, and disruptive to management. Changes make analysis using market tests less reliable and all the more difficult to interpret. These reasons aside, market studies are useful for identifying and capturing relationships between advertising and its effects. Despite its failure, the design and execution of the DoD Advertising Mix Test addressed many of the factors essential to measuring advertising return on investment.

Probably the most highly publicized private sector research on advertising return on investment was the Morell Study, which was funded by McGraw-Hill in the 1950s. (For more on this type of study, see the McGraw-Hill and other research studies in the February 1976 *Journal of Marketing Research)*. As the leading publisher of trade magazines, McGraw-Hill set out to prove that advertising supplements personal selling. The Morell study was large, involving examination of cost and sales records of some 600 firms selling industrial products. The study found that salespeople well-supported by advertising funding sold more product per dollar of sales expense, where sales expenses

were the sum of advertising expenditures plus salaries and expenses of sales people. This study is informative because industrial product marketing is somewhat analogous to military recruiting. Because personal selling is a large part of the sale, the Morell Study offers useful insights. Unfortunately, the methodology of the study requires comparison of advertising and sales dollars for each type of sales expense and sale received, which are not available in a military context.

Another experimental study in the military environment is the 1985 "Navy Enlistment Marketing Experiment" by Carrol, Rao, Lee et al. It examines the marketing effectiveness of the U.S.Navy recruiting program, and the relationship between marketing efforts and enlistment achievements. The major finding is that advertising expenditures of certain types are effective, while others are not. Joint and local advertising are found to be effective. National advertising was not found to be effective, according to other studies of that time, especially the DoD Advertising Mix Test. These studies recommend further research of national advertising effects; this thesis follows that recommendation and further incorporates local advertising and recruiting variables into the study by using local cost figures and evaluations for local advertising performance.

3. Data-Based Studies

A number of models treating aspects of enlistment supply and demand have been developed. Arima (1978) did an early, Navy-focused, study and came up with a complex, (although not exhaustive), systems modeling approach. He found that, generally on a

county basis, increasing advertising rates were not accompanied by a systematic change in enlistment rates (p.65).

The RAND corporation tested a widely recognized model that captured advertising effects using Army advertising expenditure data from the early 1980s. It was the first study using an econometric analysis of monthly advertising expenditures and a model controlling for economic conditions, local area characteristics, the magnitude and direction of recruiter effort, and levels of other recruiting resources. It suggested that at the budget and operational levels prevailing in the 1980s, Army advertising was cost-effective (Dertouzos, 1989). The RAND effort evolved out of earlier test projects of enlistment bonuses which required modeling the enlistment process and collecting Army data. RAND's initial focus was examination of local advertising; however, the study later expanded to include national advertising.

Dertouzos and Polich (D&P)'s (1989) study gauged effectiveness of the various forms of Army advertising. D&P aggregated geographical data for advertising and recruiting effort (goals and achievement), both at the national and local levels. They found significant variation in both the levels and mix of expenditures for local and national advertising. This variation exists both over time and across individual geographic areas. After accounting for variations across areas, D&P's analysis suggests that there is a one-to-one correspondence between changes in expenditures and changes in impressions (see Table 3). "Once systematic differences across [areas] are taken into account, cost data accurately reflect the penetration of advertising." D&P used cost data rather than audience or ratings data to represent advertising in specific media.

D&P simultaneously considered enlistment supply factors and then extended their model to represent contemporaneous and lagged effects of advertising. Following their previous research, they model the number of high quality recruits as a function of the number of low-quality recruits, local supply factors, advertising intensity for different media, and an index of recruiter effort. This study was particularly innovative in its treatment of recruiter effort and paid special attention to the endogenous character of the effort/goal attainment relationship. D&P's model accounts for the fact that monthly level of effort in a specific area depends upon how well recruiters are performing relative to quotas.

In a study, again based on the issue of Army recruiter effort, Berner and Daula (1993) tackle the problem of endogeneity in mission goals. Endogeneity in mission goals refers to the fact that performance affects goals, and goals affect performance. Berner and Daula examine the probabilities that each recruiting unit will be well below mission goals, within two (contracts signed) of mission goals, and well above mission goals. Commanders within two of mission at the end of the recruiting cycle are thought to exert a tremendous amount of pressure on recruiters to ensure that the mission goals are met. This reaction would cause effort to change in the range around mission goal, but not in other situations. Their results suggest that endogeneity is indeed a problem and should be addressed in models measuring the recruiting process.

A more recent effort (Charnes and Cooper ,1992, at the University of Texas at Austin) employed a different technique, Data Envelopment Analysis (DEA). Their study supports resource management and other operational production decisions. It is based on

a proposed method by Charnes, Cooper and Rhodes (1978) which evaluates the relative efficiency of Decision Making Units (DMU), using a comparison of the ratios of outputs to inputs of the units under consideration. A major critique of this kind of analysis is its inflexibility and non-accountability for environmental changes. Where other statistical approaches explicitly recognize that production in a geographical area is influenced by random shocks, i.e. variations in the environment such as changes in the political situation, these are not controlled for in the DEA specification. Statistic specifications allow for the variation in output associated with measurement errors or omitted variables to be either positive or negative. In the DEA specification the variation can only be determined if it is negative (Byrnes and Cooke, 1988). Nothing can be said about the amount and direction of inefficiencies. In addition, using DEA for this type of research is limited because it measures only against the (relatively) best efficiency of all the decision making units under consideration. Each estimate is done relative to the best in the group under research, although it could perform quite poorly.

Many other studies address the issues of enlistment supply and demand. Among these are Morey (1983), Daula and Smith (1985), Warner (1990), Kearl, Horne, and Gilroy (1990), Goldberg (1991), Lovell and Morey (1991), Lovell, Morey, and Wood (1991), Morey and McCann (1991), and Wegner (1991).

C. OBJECTIVES FOR A NAVY ADVERTISING EFFICIENCY STUDY

This study examines the issue of the optimal return on advertising expenditures. The objective is to thoroughly analyze the effects of advertising on the production of

Navy recruits. Specifically, since advertising expenditures vary by NRD, this work examines the effect of advertising on enlistment by geographic regions of the U.S., defined by the NRDs.

Identifying and collecting appropriate data constitutes the initial step of this advertising efficiency study. It includes a data call and exploratory work to see if data required are available in usable form. CNRC, DMDC and other sites provide information to identify data items necessary for conducting an econometric analysis. The second step merges the data into an accessible data base. The third step models the relationship between advertising expenditures, new recruits, and the environment, utilizing an appropriate functional form. Finally, in a fourth step, efficiency/inefficiency of advertising is estimated using an econometric model and a regression technique called the Seemingly Unrelated Regression technique.

D. ANALYSIS AND DEFINITION OF THE RESEARCH PROBLEM

The problem may be defined in two stages: Stage one creates awareness, usually equated to the respondent's knowledge about a product (Rao, 1970). For purposes of this study, awareness captures a potential enlistee's knowledge about opportunities to enlist in the Navy. Awareness is a function of national and local advertising expenditures on the several media types. Awareness of the benefits of joining the Navy may increase the probability of leading a young person to respond positively to an exposure to an advertisement or some other independent stimulus. The YATS, NRS, reach and

frequency data from advertising, and CNRC personnel and recruiters in the field have been used to explain propensity to enlist.

Advertising agencies measure national advertising efficiency. An agency provides estimates of the number of impressions generated each month by the agency's advertising on TV, radio, newspaper, outdoor advertising and in magazines, for each of the geographical regions defined as Areas of Dominant Influence (ADIs), and, for the CNRC, by NRD. An impression is defined as an exposure of one individual to one advertisement. The total number of impressions is the number of times an advertisement is run (frequency) times the number of people who see the advertisement (audience size).

The total dollar value of expenditures nationwide, for each medium by month, are distributed by the advertising agency across geographic regions to provide a certain level of gross rating points (GRPs). GRPs are a measure of the reach and frequency of the advertisement campaign. Specifically, a GRP is defined as a unit of measurement of TV, radio, or other media type advertising audience size, equal to one percent of the total potential audience. GRP is the product of impressions and reach.

Stage two is the translation of awareness into enlistment. In stage two, the number of actual enlistments, the contract attainment, occurs as a function of advertising, recruiting efforts, incentive programs, and other environmental variables such as unemployment, political situations, U.S. involvement in conflicts, and speculation about future military career opportunities.

The contract mission is defined as attracting and signing contracts with a certain number of high quality and low quality recruits over a specified period of time. The

Navy's enlistees and their contracts are classified qualitatively by high school diploma or senior status and percentile attained in the Armed Forces Qualification Test (AFQT) and ordered into cells/categories. See Figure 2 for detailed information on quality groupings.

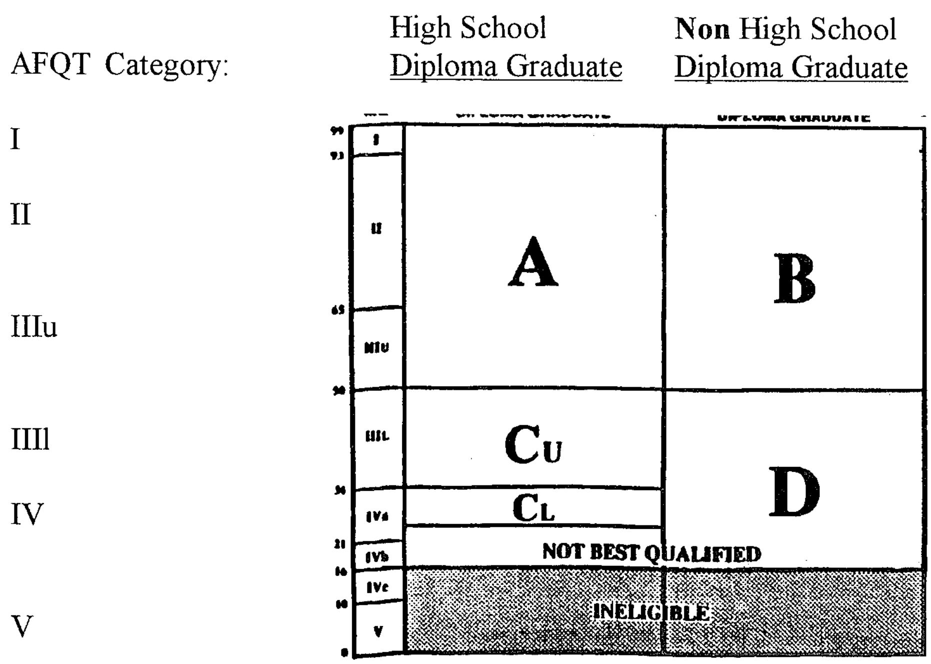


FIGURE 2: **QUALITY MATRIX**

The Navy currently tries to maintain following standards for new enlistees: 97 percent in cells A-, B- and CU-Cell (Category I-IIIu), 2.9 percent of recruits in Category IIIl-IVa, and < 0.1 percent in Category IVb or lower (Categories according to Figure 2). Due to changing demographics and changing Navy manpower requirements, determining the mix is an ongoing process, and subject to frequent adjustments.

Recruiting is the "sales" part of the enlistment process; a recruiter's job is to sell prospective recruits on a Navy career. Recruiting districts are assigned specific quotas for recruits by quality group and are evaluated based on the contracts signed. Although some low-quality recruits are taken, they are not directly substitutable for high-quality contracts. Enlistments of different recruit types are rewarded differently. In general, there is pressure on recruiters to meet their share of their unit goal as well as the NRD level enlistment goals. If a recruiter repeatedly fails to contribute adequately to meeting the mission goals, a substandard performance rating can affect future job promotions and opportunities. However, incentives for exceeding goals are mixed because surpassing a goal may result in increased mission goals in the future (see the 'endogeneity' issue in Berner and Daula, 1993). Because of the importance of the goal setting and evaluation in the recruiting process it is outlined in the following section.

1. Determination of Recruiting Goals and Quotas

Recruiting goals are assigned based on the following process: NRDs receive their male and female accession goal and new contract objective quotas by month from the Area Commander in September or October each year. The NRD Commander (CO) allocates these to subordinate units of zones (usually four or five per NRD) and recruiting stations, based on their shares of the NRD recruiters and the market, usually measured by male high school seniors and high school diploma graduates. Attainment of quotas is evaluated at least annually in most districts, and quarterly or monthly in some. Zone and

station quotas can be adjusted based on this evaluation, and most quotas are in the range of one to two contracts and accessions per recruiter per month.

CNRC annually estimates Navy Recruiting Area (NRA) and NRD shares of accessions required and new contract objective recommendations for the upcoming year. The future-year accession requirement is given to CNRC. It is an estimate of future-year new contract objective based on: (1) the number in the Delayed Entry Program (DEP) at the end of the current year, which is also the beginning of the future year; (2) the number of accessions required, which mostly come from the DEP (though the proportion of non-DEP accessions, those with less than one month in DEP increased in FY94 and FY95); and, (3) the targeted size of the DEP at the end of the future year, which has been the same size, more or less, as the DEP size at the end of the current year.

The process to determine the future-year NRD and NRA shares of CNRC accessions and new contract objective begins in May or June each year, with data collection and, months later, analysis. An NRA share by definition is the sum of the NRD shares in the NRA. CNRC estimates a model of best fit by employing time series cross-section analysis to NRD monthly male contracts, recruiters, unemployment, differences in military and civilian pay, some measures of male 17-21 year old population (such as total men, A Cell men, A Cell and Cu Cell men), and the NRD percent urban factor, for the current year, and one or more past years. CNRC uses this model to estimate future-year NRD and NRA shares of accessions and new contract objectives by month.

These male shares are evaluated to allocate the accession goal and new contract objective, because Code 222's analyses have found only the males are supply-limited. By comparison, females have been found to be demand-limited. In August and September, the estimated shares are reviewed, negotiated, and validated by a consensus of Area Commanders.. To be considered valid, the sum of NRD shares must be equal to one, and the sum of NRA shares must also be equal to one. In September and October, Area Commanders receive their shares of accession goal and new contract objectives by month for the new fiscal year, which begins in October. Area Commanders cannot modify their own share of accession goals or new contract objectives. However, Area Commanders have the discretion to recommend modification of the shares, goals and new contract objectives, but must obtain CNRC approval before implementing the changes (CNRC, Code 222E). The establishment of enlistment, or contract, goals partially drives advertising expenditures, and advertising goals are affected by a changing accession situation over time. A clearly stated advertising goal helps to justify requests for advertising funding.

E. THE BASIC APPROACH TO AN ECONOMETRIC MODEL

The various approaches to studying military advertising efficiency lead to the proposed course of this study. To analyze this problem, several steps must be completed. First, one must understand the effects of advertising goals, the establishment of advertising budgets, and how dollars may be allocated among alternative media types. Second, one must gain information on the impressions generated in the target audience. The audience

delivery, aided by the Navy's advertising agency Batten, Barton, Durstein and Osborne (BBDO), points to rough measures of numbers of people in the target population who view each advertisement campaign. Although audience delivery does not perfectly measure awareness, it is likely the best proxy for capturing the effects of an advertisement campaign on potential enlistees and their peers.

Third, budget allocations must be investigated by geographical area, time period, and type of medium. Patterns of relationships between expenditures and audience delivery, as measured by HQ-contracts (or some other measure) capturing the transition from awareness toenlistment, are examined by geographical area, time period, and media type. Finally, the study draws inferences about the relative allocative efficiency of each type of advertising to aid CNRC in optimal allocation of resources across media types. Each of these steps is described below in more detail.

1. Advertising Goals and Budgets

The common approach to preparing an advertising budget requires costing out the advertising elements required to increase sales, although one cannot prove that advertising will in fact produce the desired results. The stages of preparing the budget are (Dertouzos and Polich,1989):

> (1) Define and evaluate a target audience in terms of the media types and frequency of advertising exposures needed to elicit responses leading to sales.
>
> (2) Decide how many and what kinds of advertisements to run for each media program size and type.

(3) Estimate the cost of creating and maintaining an advertisement pool that supports the number and type of advertisements selected in (2). Note that complexity of the product offer and the receptivity of the audience (before running the advertisements) influences effectiveness of the pool.

(4) Cost out a national media budget that will provide the desired level of (continuing) exposure. Media budget size is critical: an individual advertisement will not cause awareness if not seen or heard enough times to affect awareness. Thus, the budget size limits the size of the advertisement pool. There also exists evidence that "wear out" occurs from overexposing the target audience to the same advertisements. "Wear out" provides a rationale for expanding the number and type of advertisements run.

(5) Determine costs of related essential operational elements such as a system for responding to inquiries, processing leads, and recording data needed to show advertising cost-efficiency.

Although this is a very rational approach, the verification of specific underlying assumptions, including effectiveness and efficiency, is difficult. Advertising responses are complicated, and often occur in later periods. One issue of great importance discussed in the marketing literature is the time response pattern of sales to advertising. There is no theoretical evidence on consumer behavior which adequately addresses measurement of stimulus and response with respect to military advertising.

2. Audience Delivery

CNRC tracks expenditures between national and aggregated local advertising, and across national media type on a monthly basis. For national advertising, CNRC and contracting agencies determine how to divide the expenditures across geographic regions (ADIs/NRD) to reach the appropriate audience (receive the appropriate number of GRPs/

impressions) in each region. National media purchases include advertisements on network television and network radio, nationally purchased newspaper advertisements, national magazines, direct mail, and supplements to newspapers. The purpose of national advertising is to disseminate messages to enhance the Navy's image and to describe the general character of the jobs, training and careers offered to attract the local young people enough to lead them into enlistment. Local advertising includes daily, weekly, and high school newspapers, and locally purchased spot radio advertisements. The purposes of local advertising are to promote current job opportunities, enlistment options, names and telephone numbers of recruiters, and the like. Other, nonstandard, media used is outdoor advertising, primarily the posting of billboards on major roads.

To analyze national audience delivery, in an ideal case, CNRC's advertising contractors should provide data on GRPs by ADI/NRD for the media types. To discuss the number of impressions (reach and frequency), the target population of each ADI/NRD must be collected and provided by the advertising agency for CNRC. For the patterns to reveal meaningful (and measurement error-free) information, CNRC should collect and provide advertising expenditures and recruiter data at the same geographic level.

3. Patterns of Expenditure and Audience Delivery

If a true measure of the cost-efficiency of advertising were to be found, it would be "top of mind awareness" or, the relationship between advertisement expenditures and the number of potential recruits and their peers who see an advertisement campaign. Some measure of "top of mind" awareness other than GRPs or impressions data may be quite

useful in determining the efficiency of advertisements. Studies and experiences in the Naval Postgraduate School manpower curriculum caused some reservations about using responses from the yearly YATS survey, but currently it is the best available and most appropriate estimation of awareness to use.

In addition to the steps outlined, other effects on advertising efficiency which bear upon an individual's decision to enlist, must be considered. This thesis examines the relationship of advertising resources to the supply of high-quality enlistees, including other factors such as the effect of the recruiting environment, and socioeconomic, political, and military issues.

The following section specifies many of the factors affecting the decision to enlist and the basic data requirements:

a. To track enlistments, collect contract objectives and contracts attained, collected in such a way that they can be compared with advertising data.

b. Unemployment: Obtain unemployment figures, both aggregated and for the target population for the time period being analyzed.

c. Target Population: collect information on age and gender distributions of the 18-24 year male population.

d. Recruiter effort: collect goals for missions and contracts signed.

e. Propensity to enlist: Anecdotal evidence from CNRC personnel suggests that the probability of recruiting is higher in some regions of the United States. This thesis includes regional propensity to join the Navy.

f. The model incorporates incidences of unfavorable political events to enlistment by creating dummy variables for appropriate time windows. (For example times of war, overseas peace keeping operations etc.).

g. Seasonal variances in recruiting: How can a researcher best account for seasonal variance in advertising and contracts signed? CNRC and former studies show seasonal variation. This thesis accounts for seasonal variations by incorporating them in the model estimations. Seasonal differences are accounted for by determining the level of data aggregation with respect to different levels of advertisement sensivity in the year.

h. Lagged effects of advertisement campaigns: Clearly, advertising has effects into the future. Research evidence suggests the lag in advertising and contracts signed is 1-6 months depending on level of regionality. This thesis examines advertising expenditure and impression lag structures.

4.Concept of Efficiency

To clarify the concept of efficiency, this work first draws attention to technical and allocative efficiency. It uses a simple production function $y = f(x)$, where x is the input and y is the output, that depicts the maximum y obtainable from various input levels x. Producing the maximum level of output given input levels is considered to be technically efficient. Inefficiency is measured as the amount of potential output lost or the amount of input wasted. For purposes of this study, all NRDs working on the production function curve are considered technically efficient, and either the producers above the curve or the

producers below the curve are inefficient, wasting resources or failing to reach potential output level respectively (Byrnes & Cooke, 1988).

A second theoretical approach to efficiency is allocative efficiency, which assesses Navy advertising efficiency relative to the objectives of quality attainment maximization. It considers quality maximizing NRDs as the ones not only producing the maximum output given input, but also producing the level of desired quality mix given the quality mix objectives.

F. SPECIFIC DATA REQUIREMENTS OF THE PROPOSED MODEL

The data base must include national media purchases of the various media types by ADI or at least NRD, by month. Local advertising and nonstandard media purchases should be recorded. In addition, portions of the advertisement budget that go into production, overhead, or other costs separate from running advertisements are necessary to include all induced factors cost.

Joint advertising must factor into the model. It has a positive (though no statistically strong impact) on the attainment of recruiting goals in the Navy (see Morey, 1983). However, to avoid omitting an important explanatory variable, joint advertising factors are included in the model via aggregated figures for expenditures by NRD and month.

This efficiency study must have audience delivery measures (by ADI/NRD and month), along with the target population of each ADI/NRD by month. CNRC should provide advertising expenditures and recruiter data at a level that can be matched to

ADI/NRD data by month. Additionally, fixed costs or one-time costs of a campaign should be distinguishable from the variable cost of running the campaign. It is also necessary to obtain the effects of induced costs of incentive programs like NCF and Enlistment Bonus (by ADI/NRD and month), and the target market for each region, including age distribution matched to advertising age groups.

To draw conclusions from the data collected, this thesis looks for correlations among Impressions (IMP) and expenditures, and IMP and contracts by NRD and month. The stage one relationship, or awareness of advertising, is shown by examining the correlation between expenditures and IMP received by NRD and month. This thesis uses a statistical model, measuring productivity associated with multiple inputs and outputs. The purpose of the statistical model is to obtain an optimum level of total input cost and the corresponding share of each input required to produce outputs (contracts signed) in the most efficient manner. The model uses following variables:

- expenditures on national Navy advertising (TV, radio, magazines, newspaper, direct mail, outdoor, supplement),
- aggregated expenditures on national joint advertising,
- expenditures on local Navy advertising (direct mail, newspaper)
- the number of recruiters working in the field (production recruiters),
- incentives measured by induced costs of Navy College Fund (NCF),
- the unemployment rate,
- the military/civilian wage differential for entry level pay,
- the number of people in the target market population ,

- the occurrences of unfavorable political situations to enlistment,

- lagged variables indicating advertising expenditures for one, three and six preceding months,

- goals and attainment of recruit contracts by quality cell, NRD and month,

- propensity data of YATS studies,

- geographical differences (dummies for the four Navy Recruiting Areas).

Lovell's (1991) work, among others, suggested use of a transcendental logarithmic (translog) function to express total advertising costs as a function of the mix of high and low quality contracts attained along with other variables. The translog model is suggested because it is considered more general and flexible than many forms, and allows returns to scale to vary, depending on input prices and on the level of output (the amount of output produced does not have to be in direct proportion to the inputs used in production).

This thesis follows Lovell's suggestions and uses the translog cost function and regression techniques to estimate efficient levels of advertising expenditures which have been used to reach specific goals of enlistment in recent years. Furthermore this work estimates the deviation of advertising spending from previously computed efficient levels. The next chapters show the modeling process and its outcomes.

III. MODEL IMPLEMENTATION AND FINDINGS OF THE STUDY

A. MODEL BACKGROUND

After determination of the components of advertising, based on the literature review in Chapter II, other studies, and conversations with CNRC personnel, and collecting the available data, this work incorporates the following advertising cost components into the model: nationally purchased network television and network radio spot advertisements, national magazine, newspaper and supplement advertising, direct mail and non-standard, i.e. outdoor, advertising. Additionally the thesis utilizes impressions data on the same media types, by NRD and by month, to come up with comparable unit cost performance figures.

A second portion of national advertising expenditures are joint advertising expenditures. Although they come from a different part of the defense budget, they must be incorporated in the production function, because they affect the stage one and stage two relationships. The effects of joint advertising on Navy enlistee production are not uniform according to the research literature (Morey, 1983 and 1984). This work assumes that for every month there is a certain level of impact on Navy recruit production. There are no means to estimate the specific effects, however, the proposed model incorporates the uncertain effects by making the accumulated joint expenditures an explanatory variable.

Another important component is local advertising (in FY95, 28.7% of the advertising budget or $12.2 million). It includes daily, weekly, and high school

newspapers, and locally purchased spot radio advertisements. Direct mail expenditures include nonstandard media such as outdoor advertising, booths at state fairs, materials for "career" days at high schools, advertisements in sports programs, etc.. Leads data generated from those type of media is included in the model to measure advertising performance and unit cost.

B. SUMMARY, MANIPULATION AND DISCUSSION OF DATA AVAILABLE

Input variables data:

Navy national media advertising data variables:

NTV_$	- purchases of tv advertising
NTV_IMP	- impressions of tv advertising
NRAD_$	- purchases of radio advertising
NRAD_IMP	- impressions of radio advertising
NMAG_$	- purchases of magazine advertising
NMAG_IMP	- impressions of magazine advertising
NMAIL_$	- purchases of direct mail advertising
NMAIL_IMP	- impressions of direct mail advertising
NOUT_$	- purchases of outdoor advertising
NOUT_IMP	- impressions of outdoor advertising
NNEW_$	- purchases of newspaper advertising
NNEW_IMP	- impressions of newspaper advertising
NSUP_$	- purchases of supplemental advertising
NSUP_IMP	- impressions of supplemental advertising
NALL_$	- total purchases of all national media
NALL_IMP	- total impressions of all media
LNM_$	- local advertising expenditures for mail etc.
LNMIN	- quality leads attained by direct mail local advertising

Joint national media advertising data:

JALLA_$	- aggregated purchases of joint advertising
JALL_IMP	- aggregated impressions of joint advertising

Output variables data:

MACELL	- male A- Cell contracts
MBCELL	- male B-Cell contracts

MCUCELL	- male Cu-Cell contracts
MCLCELL	- male Cl-Cell contracts
MDCELL	- male D-Cell contracts
MTOT	- male total net contracts

Environmental variables data:

MPOP1721	-resident male population 17-21 years old
MPOP2224	-resident population 22-24 years old
UNEMPRT	-percent of men and women in the workforce who are unemployed
RECRTR	-count of recruiters in production status (not on leave but on duty producing recruits)
PROP_ML	-propensity to enlist in the Navy according toYATS results for males, age 17-21(percentage)
PROP_MU	-propensity to enlist in the Navy according toYATS results for males, age 22-24(percentage)
PAYDIFF	-military and civilian entry level pay differences
NCFDM	-NCF utilization and induced cost for male recruits

Situational dummy variables:

WAR	-occurrences of unfavorable political situations to enlisting: Somalia and Haiti deployments
QUARTER1	-first quarter of the year
QUARTER2	-second quarter of the year
QUARTER3	-third quarter of the year
QUARTER4	-fourth quarter of the year
AREA1	-Navy Recruiting Area NW
AREA3	-Navy Recruiting Area SW
AREA5	-Navy Recruiting Area MID
AREA8	-Navy Recruiting Area WEST

a. Each variable file was originally laid out as a time series cross-section table of 48 columns, one for each month from 1 October 1991 to 30 September 1995 (Fiscal Years 1992 through 1995). The data are merged into one data base, ordering all variables by month and NRD as one accessible variable.

b. WAR to AREA8 are dummy variables.

c. NTV_$ to LNM_$ contain Navy national and local advertising media purchases in current year dollars, which reflect the effect of inflation.

d. NTV_IMP to NSUP_IMP contain impression data on the national media types, LNM_IN contains local leads data.

e. JALLA_$ and JALL_IMP contain joint national media advertising purchases and impressions aggregated for all joint medium types.

f. Quality contract attainment by cell:

> f1. Contract files define five measures of recruit quality according to Figure 2, page 16: A-Cell, B-Cell, Cu-Cell, Cl-Cell and D-Cell, later merged into the high quality (HQ: A- and Cu-Cell contracts) and low quality (LQ: B-,Cl-and D-Cell contracts) variables.
>
> f2. By definition, the sum of contracts attained in each cell is equal to the total of new contracts attained.
>
> f3. The files present gender neutral and male enlistment contracts attained by cell. Since new contract objectives are not assigned by cell, counterpart contract objective data is unavailable here.

g. UNEMPRT reflects a series of monthly unemployment rates for the NRDs aggregated to a overall level paying no attention to the target population.

h. The REC9585 data file provides on-board counts of recruiters trained for recruiting duty at the Navy Recruiting Orientation Unit. Recruiters generally are the strongest independent variable found in regressions to explain contract attainment as a dependent variable.

i. YATS_PRO contains positive propensity to join the Navy, expressed as a percentage, for the 16-24 year old male residents in the USA population who are estimated to have a positive propensity to join the Navy.

j. NCFD is the number of male Navy College Fund enlistment contracts produced times the average cost induced for one seat for a particular enlistment year (Chapter 30 Per Capita Amounts for Navy College Fund by Fiscal Year and NCF Enlistment Option).

j1. Per capita amounts equal the normal costs less any amortization offsets and are measured on a yearly basis.

k. PAYDIFF Civilian and Military Pay Differences expressed as a percentage of military to civilian entry level pay:

k1. The civilian pay is the estimated annual pay of 18-24 year old men and women, based on a scientific sample of this population for the Census Bureau, Current Population Survey. Estimated pay is then revised using a three year moving average since many of the NRD sample sizes were problematically small. This set of data is provided to CNRC by the Center for Naval Analyses. FY 1995 pay is based on CNA data as well as percent change in income reported by Data Resources Inc./McGraw-Hill.

k2. The military pay is annual basic military pay for new recruits; reported in current-year U.S. dollars (affected by inflation and other financial factors). Civilian basic level pay is also reported in current year dollars.

1. This thesis focuses only on the male population and male contracts according to Navy advertising objectives. (Currently, the Navy attracts a sufficient number of women.) The male supply is considered limited due to competition in the labor market. The female supply of enlistees is considered unlimited due to the high numbers of female applicants showing up at the recruiter offices.

Furthermore, CNRC provided data necessary to measure step one, the production of awareness. The Navy's Advertising Agency, BBDO, estimated the number of impressions attained by NRD for TV, radio, magazines, newspapers, supplements, direct mail, outdoor, and joint advertising expenditures. The monthly data span the time period FY92 through FY95.

CNRC also provided monthly, NRD-level data on national advertising expenditures for the period FY92 - FY95, except April - September 1995. Local advertising expenditures (on direct mail and newspaper) with generated leads, contract data, and demographic information are available for the same time period. This thesis manipulates the national figures as follows: the monthly expenditure figures are divided by impressions to provide a unit cost measure for each media type.

It defines:

P1=NTVD/NTVIMP
P2=NRADD/ NRADIMP
P3=NMAGD/NMAGIMP
P4=NMAID/NMAIIMP
P5=NOUTD/NOUTIMP
P6=NNEWD/NNEWIMP
P7=NSUPD/NSUPIMP
P8=LNMD/LNMIN
P9=JALLDA /JALLIMP,

where P1 is the cost one of TVIMP attained, P2 is the cost of one RADIMP attained, P3 is the cost of one MAGIMP attained etc. The exception is local advertising unit cost measures. This work follows advertising theory, which uses leads generated, not impressions, as a measure of advertising performance.

Additionally, the share (or portion) of all advertising expenditures made on each media type is calculated, where S1 is the share of TV, S2 is the share of radio, and S3 is the share of magazines, S4 is the share of mail, S5 is the share of outdoor advertising, S6 is the share of newspaper advertising, S7 is the share of newspaper supplement advertising, S8 is the share of local mail advertising, and S9 is the share of national joint advertising.

CNRC also provided information on contract and accession data, unemployment data and military/civilian pay differences (for entry level pay grades and information on civilian wage earnings for 17-21 year-olds, and 18-25 year-olds,) based on a recent Center for Naval Analyses (CNA) study. These data have been used to calculate a relative wage measure, expressed as a percentage. For future use of that information see the recommendations in Chapter IV.

This study defines dummy variables for unfavorable conditions to enlist. During 1993 and 1994, troops were deployed to Somalia and Haiti. The particular time periods in which advertising may have been affected occurred during the time frame (Somalia): October 92 through February 93 and (Haiti): August 94 through mid-April 94. The dummy variables for these time periods were set to 1 and to 0 for all other times.

C. PRELIMINARY DATA ANALYSIS

Table 1, in the appendix, contains a variable list with data attribute information of all data file variables and desired variables including the means and standard deviations. Table 2 (appendix) provides correlations between accumulated IMPs and expenditures, and IMPs and contracts. Relationships between particular quality cell contracts and advertising expenditures are plotted in Figures 3 and 4, and those between contracts and unemployment rates are in Figures 5 and 6 (all in appendix).

The stage one relationship, or awareness of advertising is examined by the correlation between expenditures and IMPs received. All types of advertising expenditures are correlated with IMPs of all media types. Not surprisingly, TV advertising is strongly correlated with NTVIMP (0.96755), similarly, radio expenditures are strongly correlated with NRADIMP (0.96058), magazine expenditures are strongly correlated with NMAGIMP (0.97868), and mail expenditures with NMAIIMP (0.89923). In addition, each national Navy advertising expenditure is positively related to IMPs of the other national Navy media types. Joint advertising expenditures are slightly negatively correlated to JALLIMP(-0.13064). This should be subject to further investigation. Not surprisingly, local Navy mail expenditures are correlated with NLMIN (0.47969).

The stage two relationship, initially tested by examining correlations between contracts signed and media IMP, shows the following relationships. IMPs are positively and significantly correlated with quality enlistees for all types of advertising. HQ contracts are correlated with NMAGIMP (0.46237), and LQ contracts with NTVIMP (0.36558). The relationships between A to Cu-Cell contracts and media IMPs show significant

statistical correlations: 0.47275 with NMAGIMP, 0.36604 with NTVIMP, and 0.40481 with NMAGIMP, respectively. Cl-Cell contracts are zero for all observations and D-Cell contracts correlate only weakly and insignificantly with IMPs.

To take into account the potential effects of previously accumulated advertising expenses, this thesis assumes that advertising expenses accumulate as a capital stock with respect to current IMPs. It uses a geometric lag function to find the relationship between the current IMPs and the accumulated advertising expenses. (Other influential factors affecting contracts include socioeconomic conditions, seasonal effects, recruit goal per recruiter, to name a few.) The lagged (one, three and six months) Navy advertising expenditures correlate significantly and most strongly with NTVIMP (0.57789, 0.31268, and 0.13714, respectively).

Additionally this work relates the unemployment rates to high- and low-quality contracts in Figures 5 and 6. It is interesting to note the patterns do not support common expectations about the relationships between the variables.

Expenditures on national newspaper, supplement and outdoor advertising, and attainments for Cl-Cell contracts are zero for all observations, as such the variables are excluded from the model.

The following section provides information of an Ordinary Least Squares (OLS) estimation of the proposed advertising model, specified in section E. This work uses OLS for the initial coefficient estimation, which provides unbiased and consistent, although not efficient, estimators for this functional specification (Schmidt, 1976).

TABLE 3: **INITIAL OLS ESTIMATION OF THE COST FUNCTION**

Dependent Variable: LALLCOST

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	27	13328.44749	493.64622	433.565	0.0001
Error	1008	1147.68279	1.13857		
C Total	1035	14476.13029			
Root MSE	1.06704		R-square	0.9207	
Dep Mean	8.84775		Adj R-sq	0.9186	
C.V.	12.06001				

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-9.790773	1.9591	-4.997*	0.0001
LOGHQ	1	3.052908	0.7225	4.225*	0.0001
LOGLQ	1	0.361870	0.0527	6.864*	0.0001
LOGP1	1	0.222023	0.0238	9.325*	0.0001
LOGP2	1	-0.034247	0.0223	-1.530	0.1264
LOGP3	1	-0.031480	0.0367	-0.857	0.3195
LOGP4	1	-0.296755	0.0593	-5.003*	0.0001
LOGP5	1	-0.099708	0.0205	-4.857*	0.0001
LOGP6	1	-0.05217	0.0357	-1.404	0.1606
LCONTRSQ	1	-0.399917	0.0859	-4.654*	0.0001
LLAG1	1	-0.115694	0.0316	-3.657*	0.0003
LLAG3	1	-0.026780	0.0226	-1.183	0.2371
LLAG6	1	0.281628	0.0324	8.676*	0.0001
LLAG1IMP	1	0.337001	0.0167	20.187*	0.0001
LLAG3IMP	1	0.016759	0.0151	1.108	0.2682
LLAG6IMP	1	-0.202755	0.0188	-10.748*	0.0001
LM_NCF	1	0.178680	0.0529	3.374*	0.0008
LPROPMU	1	1.227068	0.3116	3.938*	0.0001
LPROPML	1	-1.833000	0.2231	-8.212*	0.0001
LRECR	1	-0.192267	0.2648	-0.726	0.4680
LOGUNEM	1	-0.104482	0.0772	-1.354	0.1761
AREA1	B	0.310708	0.1011	3.074*	0.0022
AREA3	B	0.016620	0.0896	0.185	0.8530
AREA5	B	0.173309	0.1101	1.575	0.1155
AREA8	0	0			
QUARTER1	1	5.233265	0.2813	18.603*	0.0001

QUARTER2	1	4.951215	0.2603	19.022*	0.0001
QUARTER3	1	4.229885	0.2377	17.796*	0.0001
QUARTER4	1	4.753902	0.2841	16.731*	0.0001
WAR	0	0			
NALLIM1	1	1.153754	0.09626514	11.985*	0.0001
NTVIM1	1	-1.153754	0.09626516	11.985*	0.0001
NRADIM1	1	-1.153754	0.09626515	11.985*	0.0001
NMAGIM1	1	-1.153753	0.09626513	11.985*	0.0001
NMAIIM1	1	-1.153740	0.09626528	11.985*	0.0001
JALLIM1	1	-0.000000124	0.00000003	-3.656*	0.0003
LNMIN	1	0.000001050	0.00000083	1.258	0.2086

(An asterix denotes significance at the one percent level.)

The results in Table 3 indicate that short-term IMP elasticities with respect to Navy advertising expenses are significant for TV, radio, magazines and mail, however, only the one- and six-month lagged coefficients of IMPs are significant with elasticities around 0.3 and -0.2. Thus, last month's impression attainment has a positive effect on current month advertising expenditures, the three-month lagged IMPs have no significant effect, but the six-month lagged has a negative significant effect on Navy advertising expenditures. The highest seasonal effect on advertising expenditures is in the first quarter of the year, providing evidence for the assumption that the first quarter is the slowest time of a year with respect to responses of interested young people. Hence advertising activities have to be higher in that quarter to attract more people to join the Navy (all effects positive and significant). The highest positive and statistically significant geographical effect is for the northwest area of the U.S., providing evidence for previous findings that NRA ONE has the lowest propensity to enlist in the Navy nationwide, therefore higher expenditures on advertising are necessary to attract young people from this area.

D. THE MODEL AND ANALYTICAL METHOD

Using the data CNRC provided, this thesis formulates a translog cost model to express total advertising cost as a function of the mix of high- and low-quality contracts, advertising unit costs and environmental variables. The translog model, a mathematical formulation that is considered more general and flexible than many forms (for example, Cobb-Douglas or constant-elasticity functions) allows returns to scale to vary, depending on input prices and on the level of output. It measures productivity associated with multiple inputs and outputs. In addition, it has been used to obtain an optimum level of total input cost and the corresponding share of each input required to produce outputs in the most efficient manner. The model is a modification of a conventional flexible cost function model and serves two purposes: First, it is a descriptive tool to explain observations and find patterns of advertising expenditures among media. Second, the model predicts optimal advertising mixes and levels of enlistment contract mixes, given different recruiting scenarios.

Assumptions for modeling:

(1) the output measures are:
the Navy net enlistment contracts for high- and low-quality male enlistees (High quality ~ A and CU vs. Low quality ~ B, CL and D-cell contracts)

(2) the advertising inputs are:
expenditures on national, local Navy and joint advertising, measured in terms of impressions received (for national tv, radio, magazine, mail, outdoor, newspaper, and joint), or leads received (for local advertising)

(3) the recruiting environment variables are:
a) propensity to enlist according to yearly YATS study
b) the number of recruiters in production status
c) incentive policy measured by the number of takers and induced costs of

Navy College Fund (NCF)
d) the unemployment rate
e) the relative military wage to civilian wage
f) the number of people in the target market population (male, 18-24 years)
g) the occurrences of unfavorable political situations for enlisting
h) lagged variables of advertising expenditures in previous months

The behavioral model underlying the econometric analysis captures cost-minimizing behavior of CNRC given acceptable deviations from recruiting objectives. According to economic theory, the thesis assumes that CNRC seeks to minimize advertising expenditures to generate the desired quality mix of enlistments.

The translog model, a regression technique, estimates values for the variables under several different scenarios. The estimation provides the optimal level of national, local Navy, and joint advertising expenditures and the efficient share for each media type corresponding to each scenario. Advertising elasticities with respect to contracts attained, media type unit costs, and media type share costs result from the estimation. To obtain the total actual level of the Navy's advertising budget, two final steps must be performed. First, the efficient level of national as well as joint advertising derived from the model must be added to budgeted or projected advertising expenditures. Second, the decision-maker must apply knowledge of likely scenarios to adjust the total to the appropriate level for budgeting both national and local Navy advertising and joint advertising expenditures.

E. EMPIRICAL ANALYSIS: THE TRANSLOG COST MODEL

In the translog model, the natural log of national and local Navy , and joint advertising expenditures (the dependent variable), is a function of high- and low-quality

contracts, the number of recruiters, economic variables, the relative military wage, unit cost of each medium type advertisement, and other environmental variables (for an example, see Lovell 1991).

The structure of the proposed model estimates advertising cost minimization. It evaluates the optimal (and efficient) levels and deviations from them, hence providing inefficiency measurements. The following translog system is tailored to Navy advertising efficiency estimation and generates measures of direction, magnitude and costs of ineffective advertising allocation. The left sides of all equations consist of observed figures for Navy advertising spending levels. The right sides are efficient values of Navy advertising expenditures and their allocations across media types. Both error terms u_i and u_0 consist of the usual random error, white noise, and, most importantly, of the part of Navy advertising expenditures attributable to inefficiencies. Jondrow et.al.(1981) proposed an estimation technique for the two components of the error term in stochastic frontier models. Their technique determines technical efficiency for each observation in a sample. Based on Jondrow's work this thesis attempts to use the non-random portion to estimate deviations from the estimated optimal or efficient levels of spending. The design of the basic system is as follows and can be written for each NRD and month:

$$\mathbf{C} = \mathbf{C}(Y_1\ Y_2\ \ P_1\ P_2\ P_3\ P_4\ P_5\ P_6\ \ X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ \ Z_1\ Z_2\ Z_3\ Z_4\ Z_5\ Z_6\ Z_7\ Z_8\ Z_9\ Z_{10}\ Z_{11}\ Z_{12}\ Z_{13}\ Z_{14}\ Z_{15}\ Z_{16}\ Z_{17}\ Z_{18}) \tag{1}$$

- Efficient level of advertising budget:

$$\log(C) = \alpha_0 + \alpha_i \log y_i + 0.5 \sum_{i=1}^{2}\sum_{j=1}^{2} \alpha_{ij} \log y_i \log y_j +$$
$$\sum_{i=1}^{6} \beta_i \log p_i + 0.5 \sum_{i=1}^{6}\sum_{j=1}^{10} \beta_{ij} \log p_i \log p_j +$$
$$\sum_{i=1}^{2}\sum_{j=1}^{6} \gamma_{ij} \log y_i \log p_j + \sum_{k=1}^{18} \delta_k \log z_k + (u_0 - \theta_0)$$

(2)

This work is based on the assumption that above interaction terms

$$\alpha_{ij} = 0 \;\; ; \;\; \beta_{ij} = 0 \;\; ; \;\; \gamma_{ij} = 0 \;\; ;$$

therefore, the translog cost function is more narrowly interpreted. (It loses a few of the advantages in estimating cost levels, but gains simplicity advantages in model estimation.) Hence equation 2 can be written as a simplified translog cost function (for more see Morey, 1989):

$$\log(C) = \sum_{i=1}^{2} \alpha_i \log y_i + \sum_{i=1}^{6} \beta_i \log p_j + \sum_{i=1}^{2} \gamma_i (\log y_i)^2 + \sum_{i=1}^{18} \delta_i \log z_i$$

(3)

where:

y= number of quality contracts of type I
p= cost per unit of advertising type j
z= environmental factors of type I

- Efficient share of each advertising component j:

$$S_j = \frac{\partial \log(C)}{\partial \log(p_j)} = B_j + \sum_{i=1}^{6} B_{ij} \log p_i + \sum_{i=1}^{2} \gamma_{ij} \log y_i + (u_i - \theta_i) \tag{4}$$

where:

C: efficient level of national/local advertising cost ($C = \sum_{i=1}^{6} p_i x_i$) **(5)**

y_1: A/CU-Cell contracts

y_2: B/CL/D-Cell contracts

p_1: national tv advertising cost per impression

p_2: national radio ad cost per impression

p_3: national magazine advertising cost per impression

p_4: national mail advertising cost per impression

p_5: national joint advertising cost per impression

p_6 local mail advertising cost per local mail lead

x_1: impressions attained for national tv advertising

x_2: impressions attained for national radio advertising

x_3: impressions attained for national magazine advertising

x_4: impressions attained for national mail advertising

x_5: impressions attained for national joint advertising

x_6: local mail leads attained

z_1: unemployment rate

z_2: time-lagged advertising cost (one month)

z_3: time-lagged advertising cost (three months)

z_4: time-lagged advertising cost (six months)

z_5: time-lagged impressions (one month)

z_6: time-lagged impressions (three months)

z_7: time-lagged impressions (six months)

z_8: male, 18-24 years, propensity to enlist in the Navy

z_9: male, 17-21 years, propensity to enlist in the Navy

z_{10}: first quarter dummy variable

z_{11}: second quarter dummy variable

z_{12}: third quarter dummy variable

z_{13}: fourth quarter dummy variable

z_{14}: war = indicator dummy variable for Somalia/Haiti deployments

z_{15-18}: area dummies variables (for Navy recruiting areas I, III, V, VIII)

S_j: efficient share of advertising budget for media type j

u_0: random error of overall cost equation

u_i: random error of output type i

u_j: random error of media type j

θ_0: inefficiency of overall cost equation

θ_i: inefficiency of output type i

θ_j: inefficiency of media type j

The military/civilian wage differences for entry level pay information and the target population information are excluded from the model. This is discussed in the section on ideas for future research in the conclusion.

Equations for $\ln(C)$ and S_j (j=1,2,3,....6) comprise a system of seven equations: an advertising cost equation and 6 share equations, one for each medium type. However, the cost shares sum to unity, making one cost share equation redundant; six independent equations remain to be estimated. The efficient level of advertising expenditure (C) and the shares (S_j) are not observable; this work substitutes the observed values (C^* and S_j^*) from historical data. The substitution results in:

$$\ln(C^*) = \ln(C) + \theta_0, \quad S_j^* = S_j + \theta_j, \tag{6}$$

where $E(\theta_0)$ and $E(\theta_j)$ indicate deviations from efficiency. ($E(\theta_0)$ measures inefficiency of advertising expenditures, $E(\theta_j)$ measures inefficiencies of the media type shares.)

Economic theory underlying the translog specification requires homogeneity in input prices (that implies no money illusion or that relative prices matter rather than normal prices); hence, parameters in the deleted share equation are obtained from the following adding up restrictions:

$$\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 = 0$$

$$\beta_{11} + \beta_{21} + \beta_{31} + \beta_{41} + \beta_{51} + \beta_{61} = 0$$

$$\beta_{12} + \beta_{22} + \beta_{32} + \beta_{42} + \beta_{52} + \beta_{62} = 0$$

$$\beta_{13} + \beta_{23} + \beta_{33} + \beta_{43} + \beta_{53} + \beta_{63} = 0$$

$$\beta_{14} + \beta_{24} + \beta_{34} + \beta_{44} + \beta_{54} + \beta_{64} = 0$$

$$\beta_{15} + \beta_{25} + \beta_{35} + \beta_{45} + \beta_{55} + \beta_{65} = 0$$

$$\beta_{16} + \beta_{26} + \beta_{36} + \beta_{46} + \beta_{56} + \beta_{66} = 0$$

$$\gamma_{11} + \gamma_{12} + \gamma_{13} + \gamma_{14} + \gamma_{15} + \gamma_{16} = 0$$

$$\gamma_{21} + \gamma_{22} + \gamma_{23} + \gamma_{24} + \gamma_{25} + \gamma_{26} = 0$$

$$\theta_1 + \theta_2 + \theta_3 + \theta_4 + \theta_5 + \theta_6 = 0$$

Subtracting the estimated θ_0 and θ_j from $\ln(C^*)$ and S_j^*, respectively, results in estimation of the efficient level of monthly national, local Navy, and joint advertising expenditure (C), as well as efficient allocation of national, local Navy, and joint expenditures on TV, radio, magazine, etc. (S_j).

F. MODEL ESTIMATION

Employing the translog frontier cost function, this work uses monthly advertising data from FY92 through first half of FY95. The estimated model is given in Tables 4 (appendix) and 5. Table 4 shows parameter estimates and statistical information for the cost share equations. Table 5 contains the results for the SUR estimates for all seven equations parameter estimates.

The estimations of the share equations have a common level of adjusted R^2 of around .05, showing evidence that there is more to explain than only the geographical and time relations for one cost share factor at a time. With the exception of national magazine and mail, all contracts effects on cost share equations are significant, where TV and radio have positive and local mail and joint advertising have negative effects on the cost shares. The system of share equations, including the overall cost equation, provides a seemingly unrelated regression (SUR) model. The SUR model estimates the unknown parameters of the system. The equations are measured sequentially by OLS and the residuals are further used to form a consistent estimator of the covariance matrix. The estimations are consistent, unbiased and efficient. The SUR procedure takes into account the correlation in error terms. The results of the estimation are as follows:

TABLE 5: **SUR PROCEDURE**

Model Variables:	LALLCOST S1 S2 S3 S4 S5 S6 LOGY LCONTRSQ LOGP LOGZ LOGP1 LOGP2 LOGP3 LOGP4 LOGP5 LOGP6
Parameters:	A0 A1 A2 A3 A4 B0 B1 B2 C0 C1 C2 D0 D1 D2 E0 E1E2 F0 F1F2 G0 G1 G2
Equations:	LALLCOST S1 S2 S3 S4 S5 S6

The 7 Equations to Estimate are:

LALLCOST = F(A0, A1(LOGY), A2(LOGALLP), A3(LCONTRSQ), A4(LOGALLZ))
S1 = F(B0(1), B1(LOGP1), B2(LOGY))
S2 = F(C0(1), C1(LOGP2), C2(LOGY))
S3 = F(D0(1), D1(LOGP3), D2(LOGY))
S4 = F(E0(1), E1(LOGP4), E2(LOGY))
S5 = F(F0(1), F1(LOGP5), F2(LOGY))
S6 = F(G0(1), G1(LOGP6), G2(LOGY))

Nonlinear SUR Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq
LALLCOST	4	1032	11669	11.31	3.36263	0.1939	0.1916
S1	3	1033	139.6	0.135	0.36764	-0.0362	-0.0382
S2	3	1033	129.4	0.125	0.35403	-0.0601	-0.0622
S3	3	1033	98.0	0.094	0.30801	0.1385	0.1369
S4	3	1033	100.4	0.097	0.31186	0.1524	0.1508
S5	3	1033	70.3	0.068	0.26079	0.1326	0.1309
S6	3	1033	101.1	0.097	0.31281	0.2249	0.2234

Nonlinear SUR Parameter Estimates

Parameter	Estimate	Approx. Std Err	'T' Ratio	Approx. Prob>|T|
A0	9.684017	4.52635	2.14*	0.0326
A1	-0.211380	1.96436	-0.11	0.9143
A2	-0.716154	0.06068	-11.8*	0.0001
A3	0.118498	0.04214	0.55	0.5810
A4	-0.138725	0.04243	-3.27*	0.0011
B0	0.781656	0.15768	4.96*	0.0001
B1	-0.035361	0.003495	-10.12*	0.0001
B2	-0.118542	0.03338	-3.55*	0.0004
C0	0.386143	0.14598	2.65*	0.0083
C1	-0.013021	0.0026448	-4.92*	0.0001
C2	-0.036720	0.03089	-1.19	0.2349
D0	0.463797	0.12207	3.80*	0.0002
D1	0.025012	0.0034484	7.25*	0.0001

D2	-0.025418	0.02589	-0.98	0.3265
E0	0.676579	0.12220	5.54*	0.0001
E1	0.056422	0.0068082	8.29*	0.0001
E2	-0.084204	0.02583	-3.26*	0.0012
F0	-0.117122	0.11149	-1.05	0.2937
F1	-0.026120	0.0032439	-8.05*	0.0001
F2	0.056589	0.02375	2.38*	0.0174
G0	0.913551	0.13407	6.81*	0.0001
G1	0.087508	0.0065902	13.28*	0.0001
G2	-0.085663	0.02865	-2.99*	0.0029

After estimation information about the coefficients of the minimized equation system is available. The estimated coefficients reveal numerous expenditure elasticities of interest. With the exception of A1, A3, C2, D2, and F0 all elasticities of the estimated equation system are significant. However, the coefficients A1 and A3 are of special interest, as they reveal the elasticities of all advertising cost in the system with respect to contracts and to the square of contracts. Regardless of the fact they are insignificant, surprisingly both estimates show negative values. The necessary interpretation would mean that one percent increase in the number of all contracts will cause all advertising costs to decrease by 21%. This stands in contradiction to theoretical beliefs. After checking and rerunning the SUR equation estimation, the results are still unchanged. Further analysis is necessary, although due to time limitations, not the subject of this work.

The significant elasticities are as follows: for a one percent increase in contracts, national TV expenditures have to be increased by 12%; for a one percent increase in contracts, national mail expenditures have to be reduced by eight percent; for a one percent increase in contracts, joint national expenditures have to be increased by six

percent, and for a one percent increase in contracts, local mail expenditures have to be reduced by nine percent. Other elasticities reveal several unexpected and senseless relationships. For example, for a one percent increase in all unit costs overall expenditures have to decrease by 72 %. This surprising relationship should be subject to further investigation in future research.

An additional step should have been to evaluate the inefficiencies by comparing the observed with the estimated efficient levels of expenditures. Due to time limitations in solving the above outlined questionable elasticity-results of the SUR estimation this work cannot attempt to estimate those efficiencies utilizing the error terms of the estimation. Furthermore the model cannot project the efficiency impact of possible future advertising cost policy changes, i.e. the changes in the explanatory variables. Instead, this work is providing recommendations for future research in this area.

G. DISCUSSION

The implemented model is the simplified version of one example of many alternatives. The optimum level suggested by the general model for the advertising budget is a partial, hence special case of finding the optimum level for the total recruiting budget. An alternative way to approach the problem could be to minimize the total recruiting budget rather than the advertising budget alone. By modifying the translog model, the optimal level for the advertising budget can be obtained as a part of the optimal recruiting budget. Variations of the applied model rely heavily on available data.

One basic assumption of this thesis is that national and local advertising expenses are endogenous, while advertising operating costs are exogenous. National advertising expenses are then further classified in terms of media type (TV, radio, magazine etc). The optimal share for each media type can be obtained from the estimated model. An alternative model specification might include operating costs as endogenous input variables. Accordingly, a modified translog model may be formulated where the resulting solution provides the optimal share for national advertising, local advertising, joint advertising and operating costs from predicted total advertising expenditures.

Another assumption of this thesis and of the general translog frontier model asks for constant elasticity over the time period of the study. However, the constant elasticity assumption may not accurately reflect the current and rapidly changing environment, especially for such a wide time frame as in this work (3.5 years). One may employ a time-varying coefficient model (see Parsons, 1975, and Riddington, 1993) to accommodate interactions between recruiting efforts and market conditions. For instance, advertising elasticities may vary depending upon changes in unemployment and the intensity of international threats. One of the possible models which accommodates potential interactions is

$$\ln(HQC) = \beta_0 + \beta_1 * (1 - \exp(\beta_s * UNEM) * (1 - POL)) * AD + \beta_3 * \ln(HQC_1)$$

Where POL=1 if year > 1994; 0 otherwise, and HQC are the number of high quality contracts attained, UNEM is the unemployment rate, and AD are Navy advertising

expenditures.

In this model the short-term elasticity of high-quality contracts with respect to advertising is represented by $\beta 1$, and the long-term elasticity is $\frac{\beta_1}{(1 - \beta_3)}$ when the degree of international threats is high.

When threats are low, corresponding short-term and long-term elasticities are:

$$\beta_1 * (1 - \exp(\beta_2 * UNEM)) \text{ and } \beta_1 * (1 - \exp\frac{(\beta_2 * UNEM)}{(1 - \beta_3)}).$$

The functional form of the short- and long-term elasticities (with respect to advertising expenditures) reflect the occurrence of increasing advertising elasticities relative to an increase in unemployment during periods of low or decreased threats.

IV. CONCLUSION

The results of this work are influenced by data problems in setting up an appropriate and readable data base with necessary information to evaluate Navy advertising efficiency. CNRC could provide reasonable data and was very helpful and supportive, although, the construction (merging of over 80 raw data files of different formats into a mainframe computer accessible data base) has been and is a major hurdle of this enterprise. Technical problems with getting particular variables to work (military/civilian pay ratio, target population etc.) provide research potential for the future. To improve the existing data base CNRC should find a way to collect more types of monthly local advertising expenditures of NRDs and the generated leads data to incorporate more cost types into the model. Additional data should be collected on advertising cost induced by internet recruiting services and generated leads. For future research in this field it might be helpful for CNRC to ensure appropriate data are collected in a standard format in all areas and districts, each month and for national and local types of advertising. It would be more effective to be able to use GRP data to compute unit cost measures for the national advertising types, rather than using media type impressions. Furthermore, CNRC could insure that budgeted advertising dollars are kept current, and fixed costs of a campaign (amount spent for production and overhead) are separated from the variable costs of running the campaign. The costs for production and postage of direct mailings should be recorded for national and local advertising. Advertising related incentive data, like the Enlistment Bonus Program, and the induced cost are required.

Another point to consider is that advertising is an investment; that is, it has effects on potential recruits past the period in which advertising expenses are made. Data must not only be current, but should be kept continuously to help in examining trends in recruiting as advertising and other factors change over time.

An order to truly obtain meaningful results, the maintenance of accurate cost data on creating and maintaining an advertisement pool that supports the number and type of advertisements selected is crucial. Included in the data collection should be estimates on "depreciation" or the "wear out" effect of overexposing the target audience to the same advertisements.

A follow-up study is necessary to conduct a full translog cost function model estimation including interaction terms and all available variable information. This work laid out the basic econometric approach, constructed the fundamental data base and provided preliminary investigation of the available data when employed in a simplified translog cost function.

APPENDIX

FIGURE 3: **PLOT OF HQ VERSUS ALL$**

Plot of HQ*ALLCOST. Legend: A = 1 obs, B = 2 obs, etc.

```
  HQ
    |
    |                   A
240 +
    |     A
    |
    |
    |
220 +     A       A
    |
    |   A                      A
    |    A A  A
    |  AA  AA     A A
200 +  AA    A
    |   AAAA          A
    |   AAA A   BA
    |   A AA  A          A      A
    |  AA     A      A                              A
180 +  AB  A A A C A A       A
    |   AAA A  BBAA  AA  AA   A
    | B AA AA CAAA     B          A   A
    | CAAAA  BA   A    A  B A A
    |   C          A        A
160 +  CAAABC B              A A    A   A              A     A
    | AABBA C  A      CAA  A  A    A        A
    | CABAA A   AAA   AA A  A  A      A        A   A
    | B ADBAA    A  A A AA    B   A                        A
    | A B A  AAA AA B B    AA A AAA   A  A  A   A       A          A          A
140 +  HAAD  A A  A   A B     A  A       A  AA   A       A                   A  A
    | B AABA AAB  A A  AA  A    AAAA  A    A       A A    A   A  AA      A
    | DA  AAAAB BA BAABA     ABB A   AA  A   AAA     A  A   A                A
    | BCAABAA  AAAB AAACABCA A AA       AA        AA       A
    | F ACAAABC A   C  AA  ABA  BA  AAA A   A A          AA          A
120 +  EBBBAAAB  AB ABA A  AABACAA   C  A   AA    B    A A    A     A
    | FCBB AB A CA BA   CA   AA    A   AA  B   AB   AA                 A       A
    | FBBA AAAA BBBAAABAAAB AB CA A BB    A A AA  A A   A  A       A
    | LBBAA AA BA ABB  ABAABCBAB CBA BAA B   A  AA A A   A  A AA
    | MDABAE BAA ACAB BBBA AA  A A A A BA  BA   A   A A          A
```

```
100 + DBBAAAAD AA BAAABD A  A   BBBA AA   A B  A  AAA   A     A   A
    | MCBAAAABCAAAAAABAAA AC BA CA BB  B  A  B    A          A A        A
    | JEAAAAEBABBABCA  BA AA ACB  BA AA  BB AABA    A                   A
    | GAAA AA ACAB  AB A CA  AAAB A    AA  AA AAA      A
    | L CBA CBCBB  A  A AC  AAA    ABB AA  A     A      A    A
 80 + E  AA ABB  AAB  AB   AA    F     A  B A  B      A  A
    | Q CAA   B AD    BAACB B B AAAA  AA A   AA   AAA
    | EBE  BDA  BB B   AA  AAB   A   A A A      A   B
    | I  A B AB A  A A   BB E          A          A      A
    |    A  AAAA A  A   A  A         A A A A     AA        A
 60 + BAAB   AA       A AA AB  A      B      A A   A               A
    | A BA    A        A   AA    A A   B           B
    |   A    A   A B AA      A   A     B A               A
    | A          AA      A        A    A                 A          A
    |         AA    AA AB       A       A          A
 40 +           A       A         A          A                   A
    |                     A B
    |                        A    A
    |               A
    |   A
 20 +
    |   A                                     A
    |                        A
    |
    |
  0 +
    |
---+----------+----------+----------+----------+----------+----------+----------+----------+-----
   0       25000      50000      75000      100000     125000     150000     175000     200000

                                          ALLCOST
```

FIGURE 4: **PLOT OF LQ VERSUS ALL$**

Plot of LQ*ALLCOST. Legend: A = 1 obs, B = 2 obs, etc.

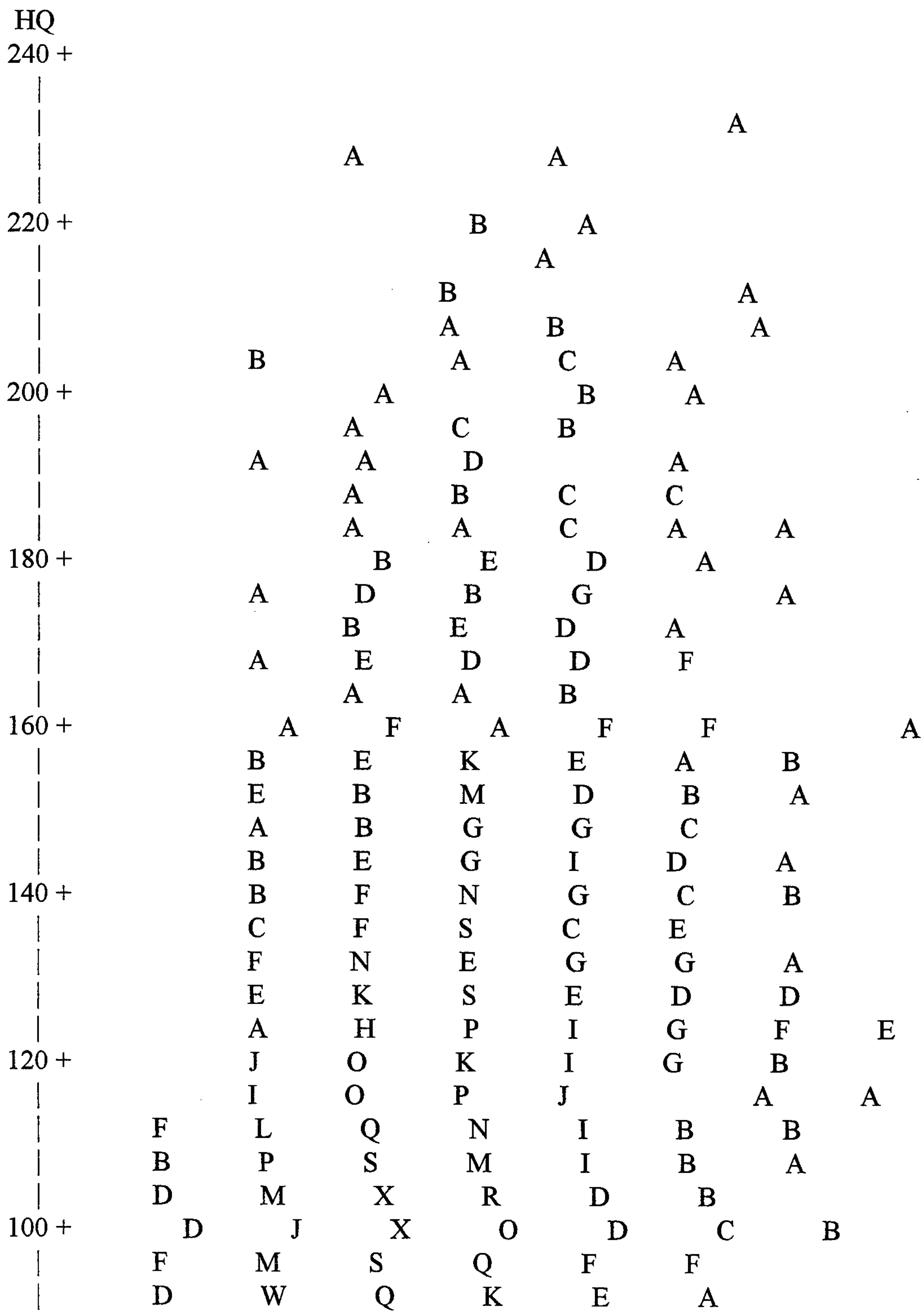
```
LQ
54 +
53 +
52 +               A
51 +
50 +
49 +
48 +
47 +
46 +
45 +
44 +                 A
43 +
42 +             A A
41 +             A
40 +                AA
39 +
38 +              A
37 +
36 +
35 +                    A     A
34 +             A         A    A
33 +          A
32 +          A
31 +
30 +                              A   A
29 +
28 +         A   A       A   A
27 +        A             B
26 + B                  A       A
25 + A   A B     A       A                A A           A
24 +         A AA                A                     A
23 +                  A          A
22 +          A
21 +              A         A
20 +   A  A       A  A         A  A      A
19 + B       A   A     A    A  B
18 +    A   A A       A
17 +     A A  A  A   AA AAA AA   A B  A      AA            A
```

```
16 + A          A       A A   B                        A
15 + AAAA BA  AA    AAB A     B    AA         A
14 + DAB  B A   B BBBA   AC      AAA      A      A    A
13 + BABAAAB  A  A B   AAA   B A     A       B
12 + CAAA  BB  A AA  C A  B CA AAA AC B  BA B  A  A  A
11 +  BABA A AA B  BA C   A   AABAABAA A  A A A A    A
10 + EFB  ACBAA A AA BAADA B A A AA A   A C    A      A   A B
 9 + DA ACA  CBCCABBBAAAA B  ACACB A AAB A A   ABA        A A      A
 8 + DEEA  BAAA A CBA B DA A ACCC B AA  A    AAA ABC          A
 7 + D AAAACCCBCBA   AABACACA   A AB     AA   A A   A AA A
 6 + J CDABC A BCAD  AA BA ACEAABBA B B AAA A  A  AAAA      AAA
 5 + I ACBB B  ACB CA CBAAACBBA  A BA BAB  B   AAA         A       A     A
 4 + HBAD CBCBDB ADCABABBABBAAABBD A AA  AABA BA     A         AA
 3 + NBAC BADC CBDAB ACDBAAACBADA A A BAA AA A A   A A AA A
 2 + IA   ABCC AD AA AB BA CBAA  AB  B      B     A   A    A        A   A A
 1 + PBBAAABCA BB AC  AA CAAAAA B      BA A  A A A       A        A      A A
 0 + ZRZVTILILHIFFFCDBGDEDDDACB C B C DA AC AB A B A    AA  A  A
---+----------+----------+----------+----------+----------+----------+----------+----------+--
   0        25000      50000      75000     100000     125000     150000     175000     200000

                                        ALLCOST
```

FIGURE 5: **PLOT OF HQ VERSUS UNEMPL. RATE**

Plot of HQ*UNEMPRT. Legend: A = 1 obs, B = 2 obs, etc.



```
   |          B         H         K         K         E
   | B         D         N         L         O         C         B
80 +            H         I        H         D                  B                  A
   | B         J        P         K         H         E         A
   | A         A         F         M         H         E         A
   | B         K         D         H         D
   |          A         E         G         D
60 +    A        B         A         H         C         A
   | A         C         C         B         C
   |          B         D         B         C                  A
   |          B         A         A         C
40 +    A        B                           A
   | A                  A         A
   |                            A
   |
20 +
   |
   |                                   A         A
   |
 0 +
---+-----------+-----------+-----------+-----------+-----------+-----------+----------
               3           4           5           6           7           8         9

                                 UNEMPRT
```

FIGURE 6: **PLOT OF LQ VERSUS UNEMPL. RATE**

Plot of LQ*UNEMPRT. Legend: A = 1 obs, B = 2 obs, etc.

```
LQ
63 +                                           A
62 +
61 +
60 +
59 +
58 +
57 +
56 +
55 +
54 +
53 +
52 +                                           A
51 +
50 +
49 +
48 +
47 +
46 +
45 +                                 A
44 +                                                     A
43 +
42 +                                 A                    A          A
41 +                                 A
40 +                                                               A
39 +
38 +                                                     A
37 +                                 A
36 +
35 +                       A                    B
34 +                       B                              A
33 +                                 A
32 +             A
31 +                                                     A
30 +                                                     A
29 +                                                     A
28 +                                           A          B          A
27 +                       A                    A          A
26 +                       A                              B
```

```
25 +              A          A         B          D         D
24 +                                 B         B          A
23 +                                          A                   A
22 +                                          A
21 +                                 B
20 +              A          C         B          B
19 +                       E                   A          A          A
18 +                       A          B          C         A
17 +     A         A                   K          B
16 +                       A          A          C         A
15 +                       C          F         E         B          C         B
14 +              A          D         H          F         B          C         A
13 +              B          A         H         J         E                   B
12 +     A         A          E         K          Q         E          G         B
11 +     A         B         I         J         N          D         A          B
10 +              D          H         N          Q         I         D          B
 9 +     A         E          N          X         T         H          D          A
 8 +              D         J          Q         U          E         K          C
 7 +              A          O         K          M          G          D         A
 6 +     C         D          M          Z         N         I                   A          A
 5 +              I         M          X          H         F         C          C
 4 +     B         F         R          V          N         L         E          B
 3 +     B         K          V         S          Q         F         E                   A
 2 +              H          H          M         S          D         A
 1 +     A         E          H          M         L         J         B
 0 +     A         K          Z         Z         Z          Z         Z          G
---+------------+------------+------------+------------+------------+------------+----------
                3            4            5            6            7            8           9

                                           UNEMPRT
```

TABLE 1: **BASIC VARIABLE STATISTICS**

Variable	N	Mean	Std Dev	Minimum	Maximum
M_NCF	2448	6.7385621	11.2060736	1.0000000	65.0000000
F_NCF	1116	3.3431900	3.2226160	0	17.0000000
PROPFU	1209	1.6692308	1.3869828	0	3.3000000
PROPFL	1209	4.1076923	0.7024428	3.5000000	5.8000000
PROPMU	2448	3.7542892	2.9211638	1.0000000	8.2000000
PROPML	2448	5.5056373	4.6504247	1.0000000	12.4000000
MCLCELL	2448	0	0	0	0
MCUCELL	2448	22.8055556	22.4184983	0	96.0000000
MDCELL	2448	0.0032680	0.0570844	0	1.0000000
MBCELL	2448	3.8566176	6.3981337	0	63.0000000
MACELL	2448	45.0788399	40.8933035	0	176.0000000
MTOT	1488	117.9126344	36.4416111	2.0000000	258.0000000
ACELL	1488	89.5215054	26.3220103	1.0000000	205.0000000
ALLD	1302	35614.69	33703.61	10.0000000	253228.00
ALLIMP	1116	303359.55	593100.55	0	4235070.00
BCELL	1488	89.5215054	26.3220103	1.0000000	205.0000000
CLCELL	1488	0	0	0	0
CUCELL	1488	46.1283602	18.8242943	-8.0000000	116.0000000
DCELL	1488	0.0020161	0.1004159	-1.0000000	1.0000000
JALLD	1116	12630.21	24947.97	0	241335.00
JALLIMP	1116	303359.55	593100.55	0	4235070.00
JMAGD	1116	8086.12	15444.99	0	110716.00
JMAGIMP	1116	251670.16	486131.26	0	3132398.00
JMAILD	1116	937.9202509	1103.15	0	6630.00
JMAILIMP	1116	4315.23	4472.06	0	28696.00
JNWSD	1116	1075.19	4540.52	0	80415.00
JNWSIMP	1116	5778.07	24798.07	0	420299.00
JOUTD	1116	0	0	0	0
JOUTIMP	1116	0	0	0	0
JRADD	1116	0	0	0	0
JRADIMP	1116	0	0	0	0
JSUPPD	1116	2530.99	7562.35	0	76951.00
JSUPPIMP	1116	41596.09	116134.21	0	1030371.00
JTVD	1116	0	0	0	0
JTVIMP	1116	0	0	0	0
MAGD	1302	12219.86	16849.99	0	121846.00
MAGIMP	1302	452265.25	591709.61	0	4319482.00
MAILD	1302	3649.02	3912.23	4.0000000	28325.00
MAILIMP	1302	6354.49	6042.89	0	78465.00
NCA	1488	144.0087366	39.7334333	12.0000000	295.0000000

NCO	1488	150.4375000	31.3123212	32.0000000	252.0000000
NEWSD	1302	921.5875576	4220.25	0	80415.00
NEWSIMP	1302	4952.63	23046.01	0	420299.00
OUTD	1302	0	0	0	0
OUTIMP	1302	0	0	0	0
POPTOT	155	310815.68	92011.70	145999.00	557756.00
RADD	1302	6246.91	7928.37	0	73187.00
RADIMP	1302	653259.24	831783.06	0	6876388.00
RECRTR	2448	70.0825163	58.0658678	1.0000000	191.0000000
SUPPD	1302	2169.42	7056.77	0	76951.00
SUPPIMP	1302	35653.79	108494.08	0	1030371.00
TVD	1302	10407.90	18751.53	0	141375.00
TVIMP	1488	164073.07	291634.80	0	2360076.00
UNEMPRT	2448	3.8390523	2.9474755	1.0000000	11.0000000
JALLDA	2448	5758.47	17977.29	1.0000000	241335.00
JALLIM1	2448	253468.02	779866.43	1.0000000	7295235.00
JALLIM2	1488	227519.66	530126.15	0	4235070.00
NALLD	2448	13184.71	22755.37	1.0000000	182149.00
NALLIM1	2448	900039.99	1470893.50	1.0000000	11774539.00
NMAGD	2448	2813.47	4464.27	1.0000000	33415.00
NMAGIM1	2448	292773.27	471863.03	1.0000000	3095126.00
NMAGIM2	1488	206979.47	231591.25	0	1336287.00
NMAIIM1	2448	10099.59	20821.31	1.0000000	127107.00
NMAIIM2	1488	2323.76	5164.36	0	78465.00
NNEWD	1488	0	0	0	0
NNEWIM1	1488	0	0	0	0
NNEWIM2	1488	0	0	0	0
NOUTD	1488	0	0	0	0
NOUTIM1	1488	0	0	0	0
NOUTIM2	1488	0	0	0	0
NRADD	2448	3323.15	6567.83	1.0000000	73187.00
NRADIM1	2448	453748.31	874565.52	1.0000000	8675825.00
NRADIM2	1488	588402.91	821493.11	0	6876388.00
NSUPD	1488	0	0	0	0
NSUPIM1	1488	0	0	0	0
NSUPIM2	1488	0	0	0	0
NTVD	2448	5536.33	14626.00	1.0000000	141375.00
NTVIM1	2448	143420.71	348752.76	1.0000000	3506299.00
NTVIM2	1488	164073.07	291634.80	0	2360076.00
ALLDA	1302	28836.40	27925.34	2.0000000	179431.00
LEADS	1488	143.8091398	197.5546366	-9.0000000	1465.00
LEADSA	1488	169.4724462	204.5328544	-9.0000000	1465.00
LNMD	2448	4367.80	10930.35	1.0000000	181504.00

LNMIN	2448	25337.75	32542.17	1.0000000	576283.00
NMAID	2448	1513.68	3227.34	1.0000000	28325.00
WAR	2448	0	0	0	0
ALLCOST	2448	19083.93	33747.47	1.0000000	254166.00
LALLCOST	1176	8.8954570	3.6549287	0	12.4457429
HQ	2448	68.2765523	61.0068356	1.0000000	242.0000000
LQ	2448	4.4150327	6.0788420	1.0000000	63.0000000
Y	2448	72.6915850	63.5220974	2.0000000	258.0000000
LAG1	1176	39724.65	39385.03	1.0000000	254166.00
LAG3	1176	39724.65	39385.03	1.0000000	254166.00
LAG6	1175	39758.46	39384.72	1.0000000	254166.00
LAG1IMP	2447	900395.33	1471089.05	1.0000000	11774539.00
LAG3IMP	2445	901065.13	1471503.56	1.0000000	11774539.00
LAG6IMP	2442	900154.85	1471606.83	1.0000000	11774539.00
S1	2448	409.7601487	2458.27	3.9344365E-6	29004.00
S2	2448	655.8247420	2914.79	0.000014407	33987.00
S3	2448	532.2506927	1996.05	0.000015994	19027.00
S4	2448	301.4711836	1490.35	0.000025956	13491.00
S5	1488	2236.42	9783.87	0	107001.00
S6	2448	970.2517855	6754.51	6.5383408E-6	181504.00
P1	2448	0.7552764	0.4203792	5.5209576E-6	1.0000000
P2	2448	0.6390141	0.4777178	0.000011481	1.0000000
P3	2448	0.5897306	4.0016078	0.0042553	197.0000000
P4	2448	0.5938919	0.3987027	0.0108469	1.0000000
P5	2448	0.6065562	0.4571775	7.4468481E-6	1.0000000
P6	2448	6.6896691	255.5631007	6.6666667E-6	12552.00
AREA1	2448	0.1372549	0.3441866	0	1.0000000
AREA3	2448	0.1568627	0.3637456	0	1.0000000
AREA5	2448	0.1568627	0.3637456	0	1.0000000
AREA8	2448	0.1568627	0.3637456	0	1.0000000
QUARTER1	2448	0.2500000	0.4331012	0	1.0000000
QUARTER2	2448	0.1875000	0.3903921	0	1.0000000
QUARTER3	2448	0.1875000	0.3903921	0	1.0000000
QUARTER4	2448	0.2500000	0.4331012	0	1.0000000

TABLE 2: **Correlations of Variables of Particular Interest:**

Correlation Analysis
Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0,
and Number of Observations:

	ALLCOST	NALLD	NTVD	NRADD	NMAGD	NMAID	JALLD	LNMD
ALLCOST	1.00000	0.78684	0.63135	0.56179	0.68553	0.40936	-0.26815	0.45421
	0.0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	1176	1176	1176	1176	1176	854	1176
NALLD	0.78684	1.00000	0.89425	0.69321	0.72786	0.58032	-0.18336	0.29651
	0.0001	0.0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NTVD	0.63135	0.89425	1.00000	0.36157	0.42243	0.45292	-0.17736	0.30849
	0.0001	0.0001	0.0	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NRADD	0.56179	0.69321	0.36157	1.00000	0.70483	0.23886	-0.21753	0.12833
	0.0001	0.0001	0.0001	0.0	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NMAGD	0.68553	0.72786	0.42243	0.70483	1.00000	0.39967	-0.04250	0.16174
	0.0001	0.0001	0.0001	0.0001	0.0	0.0001	0.1559	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NMAID	0.40936	0.58032	0.45292	0.23886	0.39967	1.00000	0.06011	0.20762
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0	0.0447	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
JALLDA	-0.26815	-0.18336	-0.17736	-0.21753	-0.04250	0.06011	1.00000	-0.11522
	0.0001	0.0001	0.0001	0.0001	0.1559	0.0447	0.0	0.0001
	854	1116	1116	1116	1116	1116	1116	1116
LNMD	0.45421	0.29651	0.30849	0.12833	0.16174	0.20762	-0.11522	1.00000
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0
	1176	2448	2448	2448	2448	2448	1116	2448
NTVIM1	0.63423	0.90607	0.96755	0.42266	0.47151	0.49106	-0.16199	0.28930
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NRADIM1	0.58177	0.71607	0.40030	0.96058	0.72158	0.28154	-0.23782	0.14645
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NMAGIM1	0.64525	0.70156	0.39602	0.69296	0.97868	0.38762	-0.05213	0.15360
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0817	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
NMAIIM1	0.36092	0.50480	0.32959	0.26865	0.44781	0.89923	0.13597	0.18005
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448

	ALLCOST	NALLD	NTVD	NRADD	NMAGD	NMAID	JALLD	LNMD
JALLIM1	0.52730	0.12650	-0.09392	0.28580	0.46266	0.09584	-0.10299	-0.05100
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0006	0.0116
	1176	2448	2448	2448	2448	2448	1116	2448
LNMIN	0.37237	0.34659	0.31652	0.21299	0.26852	0.20429	-0.05781	0.47969
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0535	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
LAG1	0.56313	0.60452	0.57055	0.37238	0.40472	0.14558	-0.24962	0.24080
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1143	1176	1176	1176	1176	1176	839	1176
LAG3	0.18136	0.24922	0.36825	0.02275	-0.11687	0.07439	-0.21760	0.15737
	0.0001	0.0001	0.0001	0.4356	0.0001	0.0107	0.0001	0.0001
	1105	1176	1176	1176	1176	1176	819	1176
LAG6	-0.11223	0.01658	0.18766	-0.13718	-0.27855	-0.14924	0.02888	0.11684
	0.0002	0.5701	0.0001	0.0001	0.0001	0.0001	0.4203	0.0001
	1061	1175	1175	1175	1175	1175	781	1175
LAG1IMP	0.45423	0.54469	0.44602	0.45499	0.45456	0.26414	-0.21346	0.20527
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2447	2447	2447	2447	2447	1116	2447
LAG3IMP	0.19033	0.35012	0.32455	0.20154	0.25325	0.23700	-0.14829	0.16253
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2445	2445	2445	2445	2445	1116	2445
LAG6IMP	-0.04665	0.22164	0.28042	0.08785	0.00570	0.10480	-0.04232	0.15357
	0.1099	0.0001	0.0001	0.0001	0.7782	0.0001	0.1577	0.0001
	1176	2442	2442	2442	2442	2442	1116	2442
AREA1	0.19061	0.30381	0.17927	0.33922	0.33456	0.17646	0.12232	0.03731
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0649
	1176	2448	2448	2448	2448	2448	1116	2448
AREA3	-0.09131	0.11076	0.07652	0.10722	0.07035	0.11852	-0.0709	0.07859
	0.0017	0.0001	0.0002	0.0001	0.0005	0.0001	0.0178	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
AREA5	-0.01036	0.13443	0.06907	0.11852	0.16104	0.17080	-0.02583	0.01862
	0.7226	0.0001	0.0006	0.0001	0.0001	0.0001	0.3886	0.3570
	1176	2448	2448	2448	2448	2448	1116	2448
AREA8	-0.07538	0.09221	0.09296	-0.00116	0.13152	0.04923	-0.02015	0.05441
	0.0097	0.0001	0.0001	0.9541	0.0001	0.0148	0..5013	0.0071
	1176	2448	2448	2448	2448	2448	1116	2448
QUART1	0.48116	0.33412	0.21601	0.33156	0.38454	0.17011	-0.22144	0.02679
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.1851
	1176	2448	2448	2448	2448	2448	1116	2448
QUART2	-0.11381	-0.11145	-0.05912	-0.11930	-0.21378	0.02059	-0.12655	-0.03922
	0.0001	0.0001	0.0034	0.0001	0.0001	0.3086	0.0001	0.0524
	1176	2448	2448	2448	2448	2448	1116	2448

QUART3	-0.21021	-0.17255	-0.14685	-0.10071	-0.16960	-0.11153	0.21252	0.12354
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	1176	2448	2448	2448	2448	2448	1116	2448
QUART4	0.14764	0.08916	0.07893	0.01279	0.14294	0.04719	0.10824	-0.02455
	0.0001	0.0001	0.0001	0.5269	0.0001	0.0195	0.0003	0.2247
	1176	2448	2448	2448	2448	2448	1116	2448

	ALLCOST	NALLDA	NTVD	NRADD	NMAGD	NMAID	JALLDA
NTVIM1	.6342	.90607	.96751	.42266	.47151	.49106	-.16199
	.0001	.0001	.0001	.0001	.0001	.0001	.0001
	1176	2448	2448	2448	2448	2448	1116

	LNMD	NTVIM1	NRADIM1	NMAGIM1	NMAIIM1	JALLIM1	LNMIN
NTVIM1	.28930	1	.46882	.43903	.366	-.07653	.30322
	.0001	0	.0001	.0001	.0001	.0001	.0001
	2448	2448	2448	2448	2448	2448	2448

	LAG1	LAG3	LAG6	LAG1IMP	LAG3IMP	LAG6IMP
NTVIM1	.57789	.31268	.13314	.45462	.33031	.25253
	.0001	.0001	.0001	.0001	.0001	.0001
	1176	1176	1175	2447	2445	2442

	AREA1	AREA3	AREA5	AREA8
NTVIM1	.20497	.08389	.06240	.10330
	.0001	.0001	.0001	.0001
	2448	2448	2448	2448

	QUARTER1	QUARTER2	QUARTER3	QUARTER4
NTVIM1	.22132	-.05505	-.16756	.09809
	.0001	.0064	.0009	.0001
	2448	2448	2448	2448

Table 4: **Share Functions Estimates**

Model: MODEL1

Dependent Variable: **S1**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	747880236	373940118	65.122	0.0001
Error	2445	14039506167	5742129	29.3119	
C Total	2447	14787386404			

Root MSE	2396.27405	R-square	0.0506
Dep Mean	409.76015	Adj R-sq	0.0498
C.V.	584.79919		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-72.479361	90.84	-0.798	0.4250
LOGP1	1	-260.11630	28.66	-9.074*	0.0001
LOGY	1	73.663072	26.57	2.772*	0.0056

Dependent Variable: **S2**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	1431400964	715700482	90.395	0.0001
Error	2445	1935833390	7917518.98		
C Total	2447	2078973487			

Root MSE	2813.80863	R-square	0.0689
Dep Mean	655.82474	Adj R-sq	0.0681
C.V.	429.04887		

Parameter Estimates

Variable	Parameter DF	Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-72.416387	107.09	-0.676	0.4990
LOGP2	1-	-262.86775	27.109905	-9.696*	0.0001
LOGY	1	75.395359	34.812988	2.166*	0.0304

Dependent Variable: **S3**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	784528270	392264135	106.983	0.0001
Error	2445	8964850030	3666605.32		
C Total	2447	9749378300			

Root MSE	1914.83820	R-square	0.0805
Dep Mean	532.25069	Adj R-sq	0.0797
C.V.	359.76246		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-1.432671	74.19	-0.019	0.9846
LOGP3	1	-259.336475	27.46	-9.444*	0.0001
LOGY	1	-10.959593	31.10	-0.352	0.7246

Dependent Variable: **S4**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	257699882	128849941	60.848	0.0001
Error	2445	5177448086	2117565.6		
C Total	2447	5435147968.7			

Root MSE	1455.18579	R-square	0.0474
Dep Mean	301.47118	Adj R-sq	0.0466
C.V.	482.69482		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-18.437376	55.86	-0.330	0.7414
LOGP4	1	-309.79211	42.85	-7.230*	0.0001
LOGY	1	15.250925	21.07	0.724	0.4692

Dependent Variable: **S5**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	2883801223	1441900611	15.354	0.0001
Error	1485	99457973075	93911092.98		
C Total	1487	142341774298			

Root MSE	9690.77360	R-square	0.0203
Dep Mean	2236.42274	Adj R-sq	0.0189
C.V.	433.31582		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob.>|T|
INTERCEP	1	8203.2362	3470.3	2.364*	0.0182
LOGP5	1	-599.1788	113.98	-5.25*	0.0001
LOGY	1	-1569.462	735.26	-2.13*	0.0330

Dependent Variable: **S6**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	3553676295	1776838147	40.193	0.0001
Error	2445	10808695026	44207341.6		
C Total	2447	111640626531			

Root MSE	6648.86017	R-square	0.0318
Dep Mean	970.25179	Adj R-sq	0.0310
C.V.	685.27162		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2961.48	267.7	11.059	0.0001
LOGP6	1	91.9031	86.48	1.063	0.2880
LOGY	1	-596.28	68.01	-8.767*	0.0001

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